



Development of a Commercially Viable Conversion of a Diesel Engine to a Spark Ignition Natural Gas Engine with the More Complete Expansion Cycle (MCEC)

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Performance Period

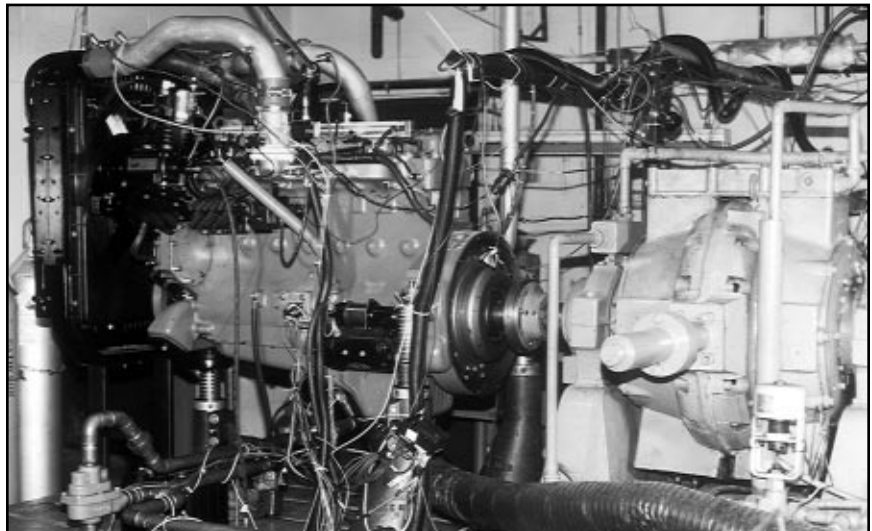
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Objective

To develop a commercially viable kit to convert the Navistar DTA 466 diesel engine to a dedicated spark ignition (SI) natural gas engine.



Navistar 466 diesel engine converted to natural gas operation using Tecogen's natural gas conversion kit

Approach

The conversion technique is based on the More Complete Expansion Cycle (MCEC), also known as the Miller cycle, so the engine retains the high expansion ratio of the diesel engine for high efficiency and is not limited by detonation. This allows the basic engine to remain unmodified except for a camshaft change. This conversion concept is being explored as the basis for an aftermarket kit; hence, an engine model in widespread use, the Navistar 466 series engine, was chosen to demonstrate the concept's feasibility.

This method of converting a turbocharged, aftercooled, four-stroke cycle diesel engine to a dedicated SI natural gas engine comprises the following steps:

1. Modify the intake cam profile, the turbo-blower boost pressure, and the aftercooler to reduce the effective compression ratio.
2. Make minor modification to the cylinder head to adopt spark plugs.
3. Add an SI system, a natural gas fuel supply system, and a throttle body for load control.
4. Incorporate a catalytic converter to reduce NO_x emissions.



Accomplishments

A conversion kit is being developed for the Navistar DTA 466 engine. The prototype engine design and fabrication, which includes all conversion kit components, is complete. Some unique features of this kit are:

- A microprocessor-based electronic engine control system
- A three-coil, direct ignition (DI) system
- A sequential-port fuel injection system
- A throttle body with a mass air flow meter, idle speed control, and speed governor
- A closed-loop control of the fuel:air ratio to reduce NO_x and carbon (CO) as much as possible
- A turbocharger that uses an integral wastegate for boost and detonation control.

The prototype engine is installed on a dynamometer, and steady-state development testing (including performance and emissions) over a wide range of operating conditions, is in progress.

A conversion kit is being installed on a school bus to optimize this procedure.

Future Direction

The next phase includes installing conversion kits on two additional vehicles, then performing a field evaluation and demonstration of the converted Navistar DTA 466 engine.

Publication

Chen, T.N., R. Mastronardi, and R. Raymond. 1994. "A New Method for the Conversion of Diesel Engines to Spark Ignition Natural Gas Engines," International Conference and Exhibition on Natural Gas Vehicles, Toronto, Ontario, Canada. October.

